



TOGETHER
for a sustainable future

OCCASION

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TOGETHER
for a sustainable future

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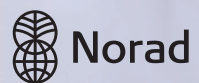
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UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

2011 AFRIMETS Metrology School:

THE RESULTS





2011
AFRIMETS
METROLOGY
SCHOOL

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INTRODUCTION	3
.....	
THE QUALITY INFRASTRUCTURE	4
.....	
METROLOGY, UNIDO & AFRIMETS	8
.....	
THE METROLOGY SCHOOL	14
.....	
PLENARY LECTURES	17
.....	
TECHNICAL SESSIONS	22
.....	
INDUSTRIAL VISITS	28
.....	
THE PARTICIPANTS	34
.....	
THE PRESENTERS	38

Special Thanks

The 2011 AFRIMETS Metrology School was conducted thanks to the support of Norad, BIPM, OIML, KEBS, the Department of Weights and Measures of Kenya and the National Metrology Institute of South Africa (NMISA).



UNIDO, Norad and AFRIMETS would like to recognize all the presenters that contributed with their unconditional time and support and give them credit and gratitude for the success of the Metrology School.



...an opportunity to learn of international best practice

The Intra-Africa Metrology System (AFRIMETS) held its first Metrology School in Nairobi from 7 to 16 February 2011. Supported by the United Nations Industrial Development Organization (UNIDO) and funded by the Norwegian Agency for Development Cooperation (Norad), the 10-day course, delivered by recognized experts from renowned metrology institutes in Africa, the Americas and Europe, gave young African metrologists an extensive introduction, both theoretical and practical, to the role, value and requirements of a quality infrastructure (QI) and, in particular, to metrology.

The School also gave metrology organizations the opportunity to exchange experiences and ideas and to learn of international best practice. The 2011 AFRIMETS Metrology School was undoubtedly a valuable learning occasion for all those who participated; it is confidently expected that it will mark the beginning of a tradition of creating and strengthening technical competences in metrology in Africa.

USE CORRECT OPERATING
PROCEDURES FOR SAFETY

○ THE QUALITY INFRASTRUCTURE

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THE QUALITY INFRASTRUCTURE



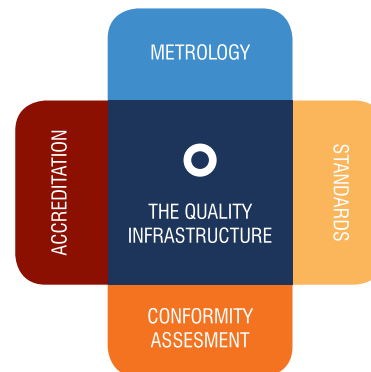
...the cornerstone of
economic growth

If developing countries are to access global markets, grow their economies and reduce their poverty, their products must meet the quality standards, technical specifications and government regulations of importing countries.

THE QUALITY INFRASTRUCTURE

Quality is the cornerstone of economic growth. If developing countries are to access global markets, grow their economies and reduce their poverty, their products must meet the quality standards, technical specifications and government regulations of importing countries – and they must be able to prove that they can do so.

Having a sound quality infrastructure is essential. A quality infrastructure involves standards, metrology, conformity assessment and accreditation.



- A standards institution, typically a national standards body (NSB), publishes documentary standards that give the requirements that products, processes or services should comply with. These may be adopted from international standards organizations.

- Metrology, the science of measurement, consists of scientific, legal and industrial metrology. It is normally served by a national metrology institute (NMI), a national calibration service, calibration laboratories and a legal metrology department.

- Conformity assessment activities include inspecting products to see if they meet the specified requirements; testing that product characteristics are those given in the standard; and certification, formally confirming that a product does meet the requirements of the standard. The testing and calibration laboratories and other bodies that carry out these activities are referred to as conformity assessment bodies (CABs).

- A recognized accreditation body confirms the impartiality and technical competence of CABs. A country may have its own accreditation body (AB) or use the services of a regional body.



A national quality infrastructure will have important links with international organizations. The most prominent in the field of standards are the International Standards Organization (ISO), the International Electrotechnical Commission (IEC) and the International Telecommunication Union (ITU) for manufactured goods, and the Codex Alimentarius Commission (CAC) and the International Plant Protection Convention (IPPC) in food and agro-processing.

International coordination in the field of scientific metrology is provided by the International Bureau of Weights and Measures (BIPM), which operates under the supervision of the International Committee of Weights and Measures (CIPM). The CIPM has established a Mutual Recognition Arrangement (CIPM MRA) under which NMIs from Member and Associate States recognize each other's national measurement standards and measurement and calibration certificates.

For this purpose, the BIPM maintains the KCDB, a publicly available database of peer reviewed calibration and measurement

capabilities (CMCs) of the participating NMIs. Engaging in the CIPM MRA enables a country's top level national measurement capability to be accepted in international markets and underpins the wider measurement capability in that country. For legal metrology, the International Organization of Legal Metrology (OIML) has a Mutual Acceptance Arrangement (MAA), which facilitates acceptance of OIML Certificates of Conformity across national borders.

Countries that lack the resources for a full national quality infrastructure can share functions through membership of regional economic communities (RECs), adopting regional standards as their national standards; examples are the East Africa Community (EAC) and the Association of Southeast Asian Nations (ASEAN).

An accreditation body gains its international recognition through participation in the mutual recognition arrangements (MRAs) of the International Laboratory Accreditation Cooperation (ILAC) or the multilateral recognition arrangements (MLAs) of the International Accreditation Forum (IAF).



○ METROLOGY, UNIDO & AFRIMETS



METROLOGY: The science of measurement

We may rarely think about metrology, the science of measurement, but it is indeed fundamental both to our personal lives and to the economic prosperity of our country.

○ METROLOGY: the importance of accurate measurement

MEASUREMENT

is a vital part of our lives



We may rarely think about metrology, the science of measurement, but it is indeed fundamental both to our personal lives and to the economic prosperity of our country.

Without agreement on what constitutes a metre, a kilogram, a litre, an ampere, etc., human activities across geographic and professional boundaries would be impossible.

Accurate measurement is absolutely essential, too, in industry: components produced and assembled in different sites need to fit exactly; technical regulations and most written standards depend on measurement; and good measurement significantly increases the value, acceptance and quality of a product or service.

Measurement is present in our daily activities

Farm products are bought by weight or size.

When we buy pre-packed goods we trust that we get what we pay for.

The volume of petrol pumped into our cars has to be accurate.

Doctors rely on temperature, blood pressure readings and laboratory test results to make a correct diagnosis.

Food inspectors measure bacteria content and pesticide residues to ensure that the food we consume is safe.

Our water, electricity and heat are metered.

In the stock markets, the exact time of a transaction is critical to the selling or buying price.

Pilots constantly monitor their planes' altitude, course, fuel consumption and speed.



The UNIDO/NORAD PROJECT

is expected to:

Enable

Enable AFRIMETS to have a pool of assessors within its member SRMOs that will provide the technical competence to assist the implementation of the CIPM MRA.

Provide

Provide a strategic roadmap that will enable AFRIMETS to identify areas and capabilities where the greatest national and regional benefits can be delivered.

Strengthen

Strengthen AFRIMETS structures and the benchmarking exercise key and supplementary comparisons (the means by which technical competence is demonstrated to the wider world, and which are a requirement for implementation of the CIPM MRA, so assisting member sub-regional metrology organizations (SRMOs).

Assist

Assist AFRIMETS set up twinning technical co-operation agreements with other RMOs.

The United Nations Industrial Development Organization (UNIDO)

is a specialized agency of the United Nations. Its mandate is to promote and accelerate sustainable industrial development in developing countries and economies in transition, and work towards improving living conditions in the world's poorest countries by drawing on its combined global resources and expertise.

The Norwegian Agency for Development Cooperation (Norad)

is a directorate under the Norwegian Ministry of Foreign Affairs (MFA). Norad is responsible for the implementation of Norway's Development Assistance Cooperation Programme. Norad administers the Ministry of Foreign Affairs grant schemes and oversees the monitoring and evaluation of Norway's development cooperation. Norad puts special emphasis on assistance that benefits the poorest sector of the community. Its efforts are tailored to the priorities of its partner countries and regions.



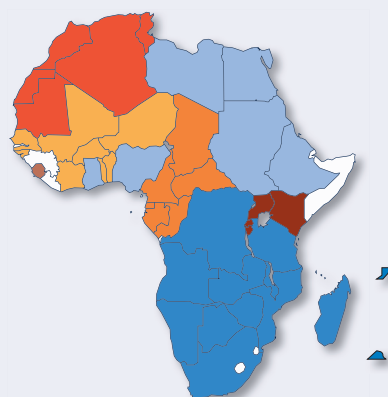
Norad

For more than 40 years UNIDO has been assisting developing countries to set up quality infrastructures: standardization, metrology, conformity assessment and accreditation.

In 2009, it set up a project, in partnership with Norad, to help strengthen AFRIMETS so that it could contribute to lowering the export rejection rates of African products caused by the non-equivalence of African and international metrology.

AFRIMETS

Currently 44 countries are part of AFRIMETS. Metrology activities have been structured into six subregions of the continent to ensure the success of regional development.



MAGMET
CEMACMET
NEWMET
ORDINARY MEMBERS
SOAMET
SADC/MET/MEL
EAMET

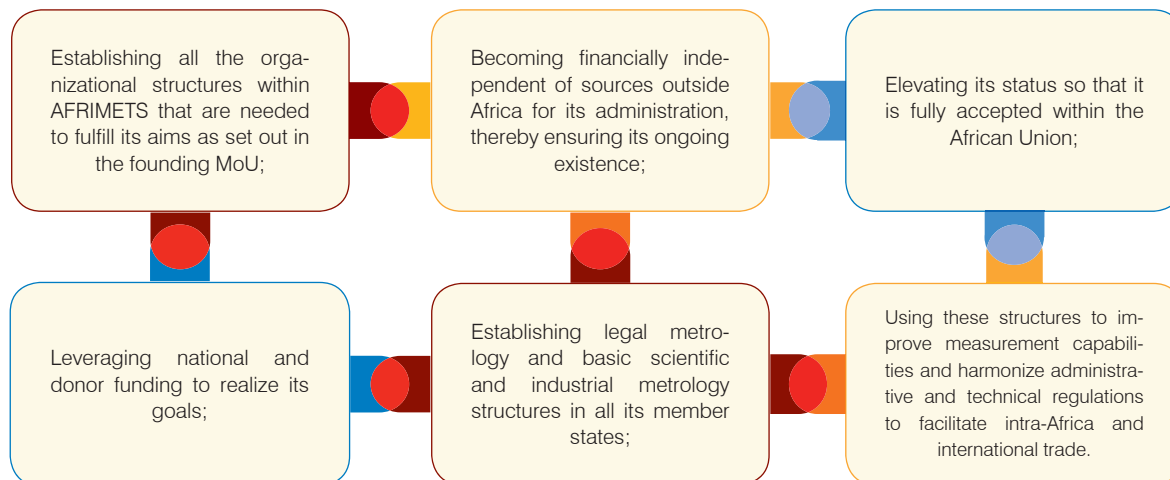
Measurement that meets international expectations cannot be applied without appropriate institutions that are able to both satisfactorily demonstrate their ability on the international stage and transfer that capability to the national user community. The lack of adequate measurement infrastructures in African countries has put them at a major disadvantage in international trade. Many are unable to manufacture to international specifications, to ensure the integrity of their export commodities, to apply quality control to their fresh produce exports, and to monitor public health and environmental conditions. And where they do have basic metrology infrastructures, there is often a lack of competence and skills; in many instances, they operate in silos and without international recognition.

But all this is now changing. The nations and sub-regions of Africa came together in 2007 to establish an Intra-African Metrology System (AFRIMETS) to further develop accurate measurement, to establish new measurement facilities, and to gain international acceptance of all the measurements that are critical to exports,

health, environmental monitoring and sanitary and phyto-sanitary issues.

AFRIMETS's primary aim is to harmonize activities associated with scientific, industrial and legal metrology. It operates as a fully fledged regional metrology organization (RMO), fulfilling the obligations stipulated in the Mutual Recognition Arrangement of the International Committee for Weights and Measures, the CIPM MRA. By enabling African countries to meet the challenge of technical barriers to trade, AFRIMETS makes a critical contribution to the fostering of trade between African countries and the rest of the world.

AFRIMETS's long-term objectives:



AFRIMETS's Mission statement is: "Promote metrology and related activities in Africa with the aim of facilitating intra-African and international trade and to ensure the safety, health, and consumer and environmental protection of its citizens", ..

leading to its vision of: "Providing fit for purpose, comparable and internationally accepted metrology facilities in Africa".



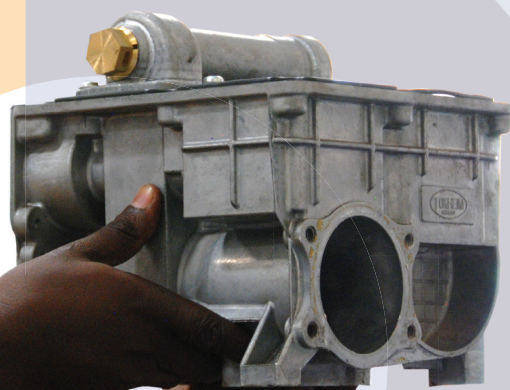
○ THE METROLOGY SCHOOL



The 2011 AFRIMETS Metrology School:

The 2011 AFRIMETS Metrology School was truly a first of its kind, not only on the African continent but also in the world of metrology: it gave participants both a good grounding in theory and hands-on experience of practical metrology.

**DESIGNED FOR
YOUNG METROLOGISTS**
from developing economies



Designed for young metrologists from developing economies, and primarily from members of AFRIMETS, the 2011 AFRIMETS Metrology School included carefully selected modules to introduce the quality infrastructure of standards, metrology, conformity assessment and accreditation, and to give a balanced theoretical and practical presentation of the basic knowledge of legal and scientific/industrial metrology needed to address metrology requirements in selected technical areas.

These presentations were delivered by distinguished experts from well-known metrology institutes around the world. The School also included field visits to enterprises where participants could witness metrology being applied.

The School aimed to assist participants to:

Fully understand the role of standards, quality, accreditation and metrology (SQAM) in modern society;

Understand the linkages in the technical infrastructure required to facilitate trade;

Understand the crucial roles that both legal and scientific/industrial metrology play in assuring product quality and fair trade;

Be conversant with the international requirements of the BIPM and the OIML;

Understand the implications of the CIPM MRA, the OIML MAA and the ILAC MAA;

Understand the role of AFRAC (the African Cooperation in Accreditation), AFRIMETS and ARSO (The African Organisation for Standardization);

Attain a working knowledge of dimensional, electrical, mass and temperature metrology.

The impact of Metrology

Prof Dr Michael Kuehne, Director of the BIPM, introduced the concept of metrology as the corner stone of a country's national quality infrastructure. He described its historical development from ancient Egypt to the international agreement to use the metre (the Metre Convention); to the International Bureau of Weights and Measures (BIPM), set up to maintain international measurement prototypes; to the International Committee of Weights and Measures (CIPM), set up to oversee the BIPM; and to the General Conference on Weights and Measures (CGPM), the overall body of member states.

Each country's national metrology institute (NMI) is responsible for its national measurement standards, for their traceability to the international system of units (SI), and for disseminating the SI within the country. The CIPM Mutual Recognition Arrangement (CIPM MRA), established to achieve worldwide acceptance of the NMIs' national standards and certificates, is an important tool for gaining international recognition of national standards and reducing technical barriers to trade.

The four pillars of a national quality infrastructure

Prof Dr Ahmed El Sayed, Head of the NIS Office of International Affairs (NIS-OIA) and Assistant Secretary General of the Arab Federation for Metrology (AFM) described in detail (i) the four pillars of a quality infrastructure (QI): metrology, standardization, conformity assessment and accreditation; (ii) the benefits of a QI – it facilitates participation in global trade by supporting competitiveness, the avoidance of technical barriers to trade (TBTs), and the achievement of environmental, health and consumer policy goals; and (iii) the different costs and modes of financing for each pillar.

He emphasized the need to harmonize the QIs of African countries with those of the world to ensure acceptance of their traded products and services. However, a developing country need not invest heavily in the full QU all at once. (Delivered by Mr. Sammy Koskei Milgo, former director of KENAS (Kenya Accreditation Service)).

Standards in today's world

Mr Oswald Chinyamakobvu, SADC Secretariat, Botswana, outlined the history of standards – documents that establish uniform technical specifications, criteria, methods, processes or practices – and examined how they affect the economic development of African and other developing countries. They facilitate trade, support competitiveness and protect consumers; without them, a “quality culture” cannot emerge in any society. Initially, the provision of information on standards is more important than developing them, but countries will benefit most by being active “standards makers” rather than “standards takers”.

He described the role of standards in the quality infrastructure; the hierarchy of standards – personal, organizational, national, regional and international; the principles of standards development and their application; the role of national standards bodies (NSBs); the distinction between voluntary and mandatory standards, the latter also known as technical regulations; and the importance of international standards in avoiding technical barriers to trade (TBTs).

PLENARY LECTURES

Metrology and testing

Mr Mourad Ben Hassine, INNORPI, Tunis, expanded the concept of metrology, another pillar of the quality infrastructure, to the field of testing. Testing is required to demonstrate how well safety regulations and standards are being met.

He highlighted, in particular, the need for metrology to give international recognition to testing; gave an overview of metrology and testing; emphasized the importance of measurement testing in society, the traceability of measurement and the role of conformity assessment bodies; described the intrinsic characteristics of national metrology systems; and provided recommendations on testing.

Accreditation: SADCAS's innovative model

Mrs Maureen Mutasa, SADCAS, highlighted the need for independent third party accreditation of the competence of conformity assessment bodies (CABs) – testing and calibration laboratories and inspection and certification bodies. However, only a few countries and regions in Africa have internationally recognized accreditation bodies, SADCAS being one. SADCAS provides a practical, cost-effective means for CABs to access accreditation services, and has already made significant strides towards international recognition.

When an accreditation body becomes a signatory to the ILAC/IAF mutual/multilateral recognition arrangements, its accredited certificates are accepted globally. Accreditation thus plays a key role in supporting competitive markets and cross-border trade.

Accreditation (Applied)

Mrs Maureen Mutasa, SADCAS, in the continuation of her first session on accreditation, gave an overview of the five stages of the accreditation process: application and review of documents, including the organization's quality manual; pre-assessment of its readiness for an initial assessment; initial assessment onsite, covering all aspects of the organization's scope of application; surveillance assessment after accreditation has been granted but not more than 12 months after the initial assessment, and thereafter annually for the first 5 years; and reassessment at the end of these five years.

She also gave details of accreditation costs and timescales.

Scientific metrology and the CIPM MRA

Mr Andy Henson, BIPM, described the role of the CIPM MRA. By the end of the 20th century, the BIPM had extended its range to cover all forms of measurement, and most countries had set up national metrology institutes (NMIs) to provide their own national measurement standards. With so many countries active, bilateral arrangements between individual countries were becoming too cumbersome to ensure the acceptance of the equivalence of their standards.

To address this issue, the CIPM set up a CIPM MRA for national measurement standards and for calibration and measurement certificates issued by NMIs. This has now been signed by the representatives of 86 institutes – from 50 Member States, 33 Associates of the CGPM, and 3 international organizations, as of 1st August 2011, – and covers a further 137 institutes designated by the signatory bodies. This session covered in detail the benefits of investing in measurement and of participating in the CIPM MRA, and gave guidance on the mechanics of participation.

Legal metrology overview

Mr Brian Beard, NRCS, South Africa: The main function of a legal metrology system is to provide reliable conformity assessment of regulated products so that regulations can be enforced. Legal metrology brings credible measurements to health, safety, protection of the environment and law enforcement; provides a level playing field for commercial and economic growth; promotes international trade by bringing confidence to measurements; enables the accurate collection of government taxes; brings the full national benefit from commodity exports; and reduces fraud and disputation costs.

A legal metrology system may be fully funded and implemented by the government, devolved to other levels of government or partially privatized. Legislation, however, should remain with the central government. The international forum for legal metrology is the International Organization of Legal Metrology (OIML).

Application of quality systems

Dr Elsie Meintjies, Ex BOBS, described the role of conformity assessment in the application of quality systems. Conformity assessment activities provide evidence that a product, system or person or body fulfils certain quality requirements. It is used to assure the parties in a transaction (buyer and seller) that the product, process, system, body or person does in fact conform to the requirements of a standard.

She described the supply chain context of conformity assessment; the conformity assessment structure, giving details of the role, features and limitations of each component of the structure: testing, calibration, inspection, product certification and system certification; conformity assessment provisions in the World Trade Organization (WTO) Technical Barriers to Trade (TBT) Agreement; and factors related to the acceptance of conformity assessment certificates.

PLENARY LECTURES

Comparisons, calibration and measurement capabilities and the Key Comparison Database (KCDB)

Dr Wynand Louw, NMISA, South Africa: the BIPM maintains a publicly available database (KCDB) of the calibration and measurement capabilities (CMCs) of each of the national metrology institutes (NMIs) in the CIPM MRA, related to its artefact standards, its realization of the SI, and its analytical abilities. This data is based on the results of key comparisons conducted regularly between the NMIs, with the Regional Metrology Organizations (RMOs) playing a key role in the international benchmarking that is required.

When the CMCs of a country's national metrology institute (NMI), supported by a proper quality system, are accepted through an RMO peer review process and published by the BIPM, are properly disseminated to the measurement community and if their activities are supported by a proper quality system, especially accreditation, the country's measurements will be acceptable to the international markets. Laboratories will be able to identify appropriate providers (NMIs) for traceability and customers will be able to identify appropriate providers for any calibration or analytical services.

Legal metrology and the OIML MAA

Mr Ian Dunmill, OIML, described the International Organization of Legal Metrology (OIML) and its potential contribution to developing countries' economies, particularly African countries. Participation in the OIML Mutual Acceptance Arrangement (MAA) facilitates the global certification of measuring instruments; assists countries which do not have their own test facilities; facilitates compliance with the WTO TBT Agreement; enables the exchange of information, experience and good practices; and ensures that other countries' facilities can be relied on. It benefits manufacturers of instruments by avoiding the duplication of tests for type approval in different countries, saving time and money.

It is important that developing countries ensure that OIML publications are relevant to them. RMOs (regional legal metrology organizations) have a key role in facilitating the implementation of OIML Recommendations; in ensuring that regional needs are addressed; and in organizing training.

Building standards, metrology and conformity capacity in Africa: UNIDO's approach

Mr. Lalith Goonatilake, UNIDO, emphasized the key role of trade in developing countries achieving income growth and reducing poverty – a 1% growth in trade brings a 0.5% increase in national income. With 80% of global trade in manufactures, industrial exports are key. He described how UNIDO, with its 3C approach of compete, conform and connect, assists countries to exploit trade opportunities. Its wide range of projects helps them to establish and strengthen quality infrastructures; develop competitive industrial capacity; deal with the increasing sophistication of standards and quality requirements; and achieve and demonstrate the compliance of their agro-food exports.

UNIDO projects also support national quality infrastructures and conformity assessment bodies at regional level, and UNIDO can draw on its strategic partnerships with international organizations (BIPM, OIML, ISO, ILAC, IAF) to support developing countries.

Overview of AFRIMETS

Dr Wynand Louw, Chair of AFRIMETS, described the history, role and activities of AFRIMETS. Sensitizing stakeholders to the metrology needs in Africa is a role for all African countries, but especially for AFRIMETS, since it brings together sub-regional metrology organizations (SRMOs) to work towards the common goal of providing accurate measurements to meet the needs of industry and consumers in Africa.

AFRIMETS is now well established as the RMO for Africa, its structures are all in place, legal metrology is an active component, all the duties stipulated in the CIPM MRA have been fulfilled, and pilot studies and key and supplementary comparisons are being conducted.

Quality Infrastructure in Africa: PTB's technical cooperation in Africa

Ms Kathrin Wunderlich, PTB, Germany: One of the leading national metrology institutes worldwide and an important national provider of metrological services in Germany, PTB assists developing countries/ transition economies to establish quality infrastructures (QIs), providing policy, institutional, networking and technical support.

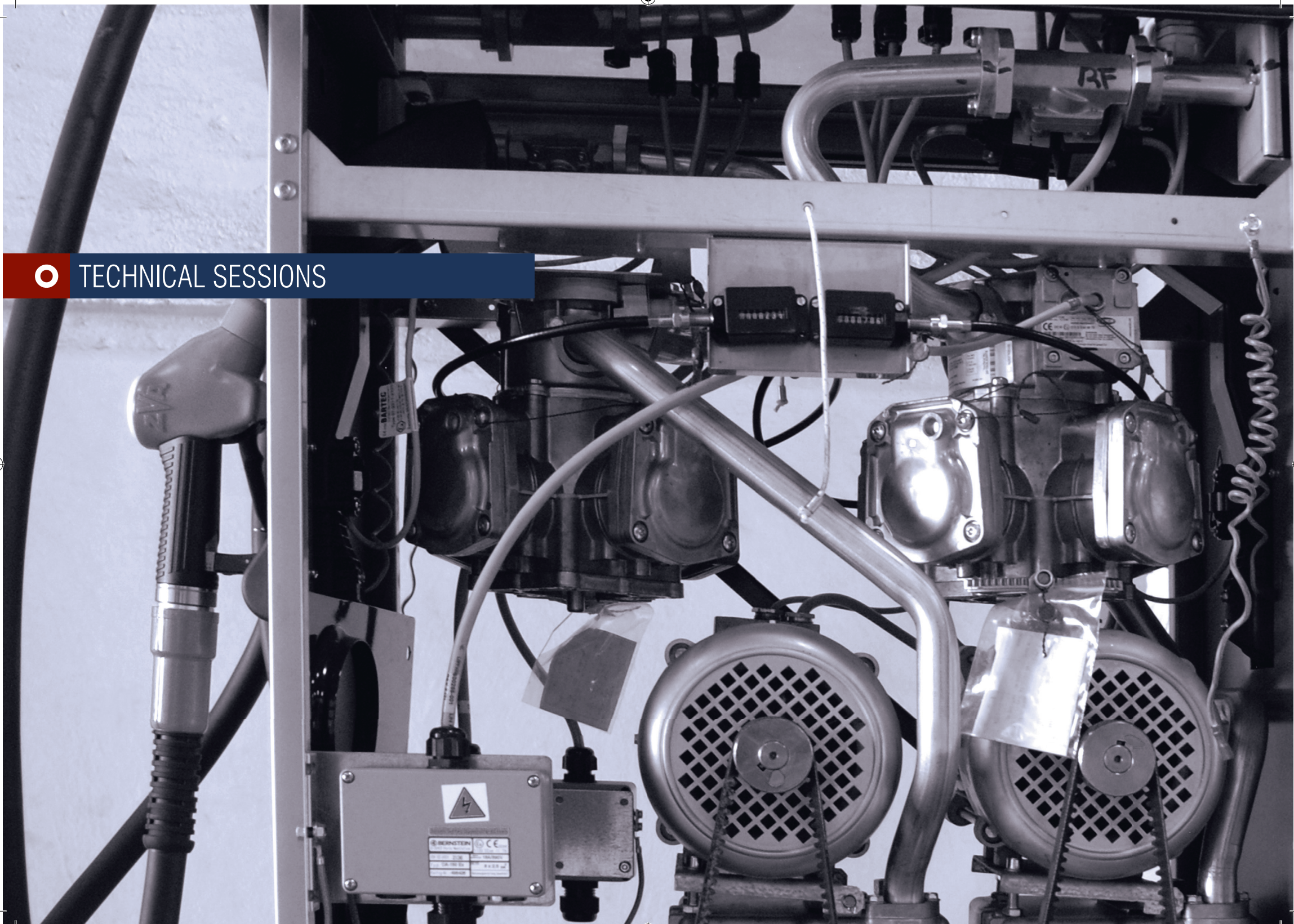
In Africa, it takes a pan-African approach with a combined focus on national QI institutions; on regional QI associations, e.g. SADC, EAC; and on strategic alliances with, for example, UNIDO and BIPM, that link national QI institutions and international QI associations. It was emphasized that African states should not only be an integral part of the international quality network but that their voice should become stronger.

Laboratory safety

Mr Dennis Moturi, KEBS, Kenya: The goal of a laboratory safety programme is to minimize the risk of injury or illness to laboratory workers by ensuring that they have the training, information, support and equipment needed to work safely in the laboratory, regardless of its scope of testing or calibration. The responsibility for laboratory safety rests with every member of staff.

The presentation described, in detail and with consideration of a wide range of hazards, how a laboratory safety programme should be implemented: formulate a safety policy and objectives; consider safety factors in designing the laboratory; introduce safe work practices and procedures; ensure that the laboratory has adequate personal protective equipment; and give full attention to ergonomics.

○ TECHNICAL SESSIONS





Theoretical and technical knowledge

The 2011 AFRIMETS Metrology School was designed to provide participants with both theoretical and technical knowledge in a number of technical fields in both languages English and French.

○ TECHNICAL SESSIONS

The 2011 AFRIMETS Metrology School was designed to provide participants with both theoretical and technical knowledge in a number of technical fields, the prioritization of which was determined by questionnaires completed by AFRIMETS member institutes in the early planning stages of the School.

To accommodate Anglophone and Francophone Africa, the full 10 days had to be presented in both English and French. This meant that technical experts had to be selected who could provide the same information in both languages in the technical sessions.

Introduction to measurement uncertainty

Dr Georges Bonnier, CAFMET: Regardless of the scope of measurement – length, weight, volume, etc. – all measurements are subject to uncertainty, and the measured value is only complete if it is accompanied by a statement of the associated uncertainty. A measured value without some indication of its uncertainty is useless.

The presentation gave a detailed and comprehensive introduction to understanding and calculating measurement uncertainty, a must for metrologists today.

The international system of units

Dr Richard Davis, BIPM: The seven base units of the international system of units (SI) – second, metre, kilogram, ampere, Kelvin, mole, candela – provide the references used to define all the measurement units of the international system.

The SI is not static but continuously evolves to match the world's increasingly demanding requirements for measurements at all levels of precision in all areas of science, technology and human endeavour. It is essential that every metrologist fully understands the SI. The presentation described the SI in detail.

Mass and volume metrology

Dr Richard Davis, BIPM: Accurate measuring of mass and volume in Africa affects almost any product traded in the continent, whether domestically or internationally. Oil, minerals, pharmaceuticals, fresh fruit and vegetables require accurate measurements to determine their purity, specific content and bulk weight. The calibration and control of pumps, balances and meters ensure that customers get what they pay for and protect their purchasing power.

This training session, which included practical sessions at Kenya Weights and Measures Laboratory in carrying out calibrations and comparisons, considered why we need mass standards, balances and good environmental conditions in metrology; how we can be confident that our measurements are correct; traceability in practice; OIML R 111: an essential reference, but not always user friendly; and the metrological triangle of mass, volume and density.

Dimensional metrology

Mr Miguel Viliesid, CENAM, Mexico: Dimensional measurements are important in the African economy. Industry requires the use of a variety of physical scales to determine the dimensions of products. Accurate measurement of dimensions ensures the compatibility of components in the value chain, so that products manufactured in Africa can fit and be assembled abroad and vice-versa.

This session, which included practical exercises at the KEBS laboratory, covered the history of the length unit; the present definition of metre—realization with a laser stabilized frequency; traceability in dimensional metrology (DM); gauge blocks (GBs) and GB calibration by interferometry; uncertainty sources in DM and general good practices; micrometer calibration; uncertainty assessment of micrometer calibration; GB calibration by mechanical comparison; uncertainty assessment of GB calibration by mechanical comparison; caliper calibration; and uncertainty assessment of caliper calibration.



Practical session
on mass metrology

Practical session
on dimensional metrology

○ TECHNICAL SESSIONS

● TO PROVIDE THEORETICAL AND TECHNICAL KNOWLEDGE

Temperature measurements

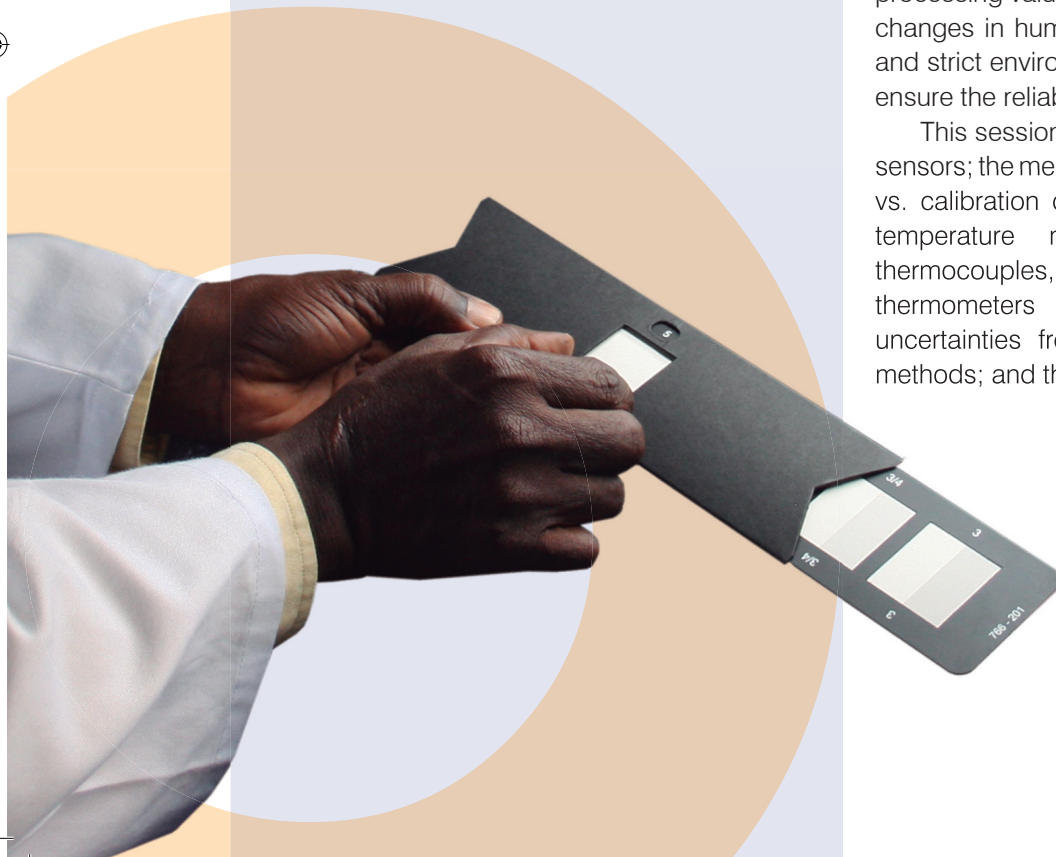
Dr Georges Bonnier, CAFMET: Temperature measurement affects a wide number of areas: health (thermometers); food safety, as this needs to be carefully monitored in every step of the food processing value chain; and the environment, as changes in humidity, etc., need to be identified and strict environmental conditions controlled to ensure the reliability of tests.

This session covered temperature scale and sensors; the mesurand; measurement conditions vs. calibration conditions; sources of errors in temperature measurements; thermometers, thermocouples, thermistors, liquid in glass thermometers and PRTs; understanding uncertainties from thermal effects; calibration methods; and the uncertainty budget.

Metrology in electricity: quantities, standards, definitions

Dr Luc Erard, LNE, France: Much of life today depends on the electric power distribution system. Keeping the national electric grid in good working order – and ensuring power is measured accurately and billed fairly – requires a set of standards for electric power measurements. It is particularly important for African countries that energy is distributed efficiently. Power outages are common, and extended periods without power affect both consumers and industry and can be life-threatening, for example, to patients in hospitals and during extreme weather. Metrology in electricity supports reliable power delivery, public safety, and accurate pricing.

This session, which included practical work at KEBS laboratory, covered the farad, the ohm and the volt electrical units; general definitions; disturbing phenomena and their consequences; the relationship of the electric units and their practical realizations; and uncertainty calculations.





Francophone students
preparing group assignments



Session
on temperature measurements



Industrial visit
to General Motors East Africa



Plenary session



Participant
contributing to plenary session



Group photo:
presenters and participants



Practical training
on dimensional metrology



Practical training
on mass metrology



 INDUSTRIAL VISITS

CTB2616



The industrial applications of quality systems

Participants witnessed the fundamental importance of metrology and calibration and the impact of legal and industrial metrology on product quality, safety, trade, the environment and consumer protection.

INDUSTRIAL VISITS

An important component of the 2011 AFRIMETS Metrology School programme was the field visits that participants made to five Kenyan companies. This allowed participants to see the industrial applications of quality systems and, of special value, they were able to appreciate the fundamental importance of metrology and calibration and the impact of legal and industrial metrology on product quality, safety, trade, the environment and consumer protection.

General Motors

General Motors East Africa Limited assembles a wide range of Isuzu trucks and buses. It is the largest manufacturer of commercial vehicles in the Eastern Africa region and has over 30 years experience in local assembly and service. Vehicles are engineered to suit local operating conditions, with up to 50% local content on some models. The company continues to develop and modify designs to customer requirements.



GlaxoSmithKline.

GlaxoSmithKline (GSK) is a leading global research-based pharmaceutical and healthcare company. Its Nairobi plant manufactures oral care and nutritional products, tablets and powders and some food products, which are distributed throughout East Africa. It imports the bulk of its raw materials. The plant also has a small development laboratory



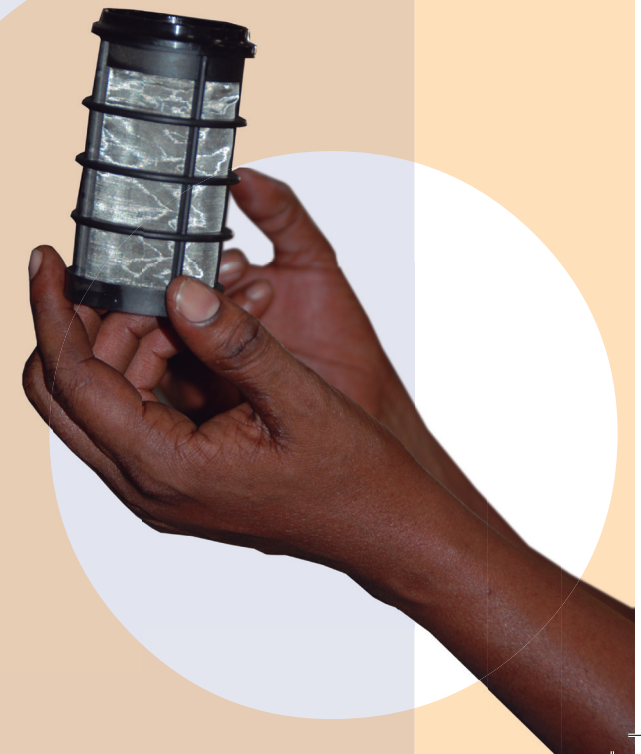
Kenya Breweries Ltd.

Kenya Breweries Ltd. (KBL) is a subsidiary of East African Breweries Ltd. and a leading branded alcohol beverage business, with breweries, distilleries, support industries and a distribution network across the region. It produces a wide range of beer and spirit brands.



The industrial visits helped the participants recognize the serious impact on the end product and the consumer of a plant or process failure or an instrument malfunction caused by wrongly calibrated equipment as well as to identify the legal metrology implications of industrial processes; this clearly highlighted the importance of the metrologist and the national metrology institute.

THE IMPORTANCE OF THE METROLOGIST



INDUSTRIAL VISITS

Group Assignments:

Participants were required to give feedback presentations from the industrial visits, where they reported on their observations of standards, quality, accreditation and metrology in industry.

New Kenya Co-Operative Creameries Ltd.

New Kenya Co-Operative Creameries Ltd. (NewKCC) is the oldest dairy processor in Kenya. It supplies a wide range of dairy products, including fresh milk, cheese, long-life milk, fermented milk, yoghurt and ghee, and has other products under development. The visit included the plant that mainly handles milk, but also makes yoghurt, mala and butter.



Petroleum and Industrial Services Ltd.

Petroleum and Industrial Services Ltd. (PIS) installs and maintains service station equipment all over the East African region, and specializes in petrol pump refurbishing. It repairs and verifies the electronic-controlled boards in the dispensing units, and calibrates the volume meters. Inspectors from Kenya Weights and Measures regularly visit the petrol pumps to verify the pump dispensing volumes, and put a verification stamped seal on the volume meters in the pumps.



AT EACH ENTERPRISE, participants were prompted to identify:

1 Major measurements
The major measurement units that affect the various stages of a process;

2 Critical measurements
The measurements that are critical for the final product: temperature, pressure, torque, dimension, volume, mass, etc;

3 Quality assurance
The quality assurance (QA) requirements and quality control (QC) points throughout the process;

4 Quality control
The measurement infrastructure support for the quality assurance and quality control of products;

5 Health & safety
Health and safety requirements and their implementation;

6 Measurement tolerances
The importance of measurement tolerances during the production process.



○ THE PARTICIPANTS

HEAVY COMMERCIAL
ASSEMBLY LINE

ID NO M026
CORROSIVE WASTE





Agents of change

The Metrology School trained applicants with the highest potential to become agents of change in their own countries.

METROLOGY SCHOOL / THE PARTICIPANTS



The 2011 AFRIMETS Metrology School was truly a first of its kind, not only on the African continent but also in the world of metrology: it gave participants both a good grounding in theory and hands-on experience of practical metrology. Nor were the industrial visits just sightseeing trips; they engaged participants in actually applying what they were learning.

Participants were able to engage with expert metrologists from well-known metrology institutes in question-and-answer sessions during the technical presentations and core training sessions, and to participate in other interactive activities: industry visits, with guidelines on the quality infrastructure elements to observe and learn about; laboratory sessions; group work in preparing a written report on the industrial visits; a vote of thanks to the industries visited; a vote of thanks to the five sponsors of the event (BIPM, KEBS, Norad, OIML, UNIDO and the Weights and Measures Department of Kenya) and the delivery, by a nominated member, of the group feedback report in a presentation on the last day.

They returned to their own countries with an enriched appreciation of the importance of an effective quality infrastructure and all its component parts, and a clear understanding of what it can deliver and what it requires; with a sound understanding of the role of metrology and a solid grounding in its practice; and with an increased awareness of how their country's infrastructure can benefit from links with international organizations. They will be well prepared to become agents of change in the crucially important area of supporting the development of their countries' capacity to produce goods that meet the demanding requirements of global markets, and to thereby make a significant contribution to economic growth and poverty reduction.

METROLOGY SCHOOL / THE PARTICIPANTS

Over 100 applications were received from over 40 countries. The Metrology School carefully selected applicants with the highest potential to become agents of change in their own countries. Their academic and professional background and their current responsibilities at their laboratories were examined, and a total of 80 were accepted, the number being somewhat restricted both to ensure the quality of the training and to allow for small groups in the practical laboratory courses.

There were seven candidates from outside Africa: three Inter-American Metrology System (SIM) participants from Canada, Haiti and the USA; two Asia Pacific Metrology Programme (APMP) participants from Sri Lanka and Nepal; and two from UNIDO projects in Bangladesh and Bhutan.

● Benin	(2)	● Mauritania	(1)
● Botswana	(1)	● Namibia	(2)
● Burkina Faso	(2)	● Niger	(1)
● Burundi	(2)	● Nigeria	(2)
● Cape Verde	(1)	● Rwanda	(2)
● DR Congo	(4)	● South Africa	(3)
● Egypt	(2)	● Senegal	(1)
● Ethiopia	(2)	● Sierra Leone	(2)
● Gabon	(2)	● Swaziland	(1)
● Gambia	(1)	● Tanzania	(2)
● Ghana	(2)	● Togo	(2)
● Guinea Bissau	(2)	● Tunisia	(2)
● Côté d'Ivoire	(2)	● Uganda	(1)
● Kenya	(16)	● Zimbabwe	(2)
● Lesotho	(1)	● SIM	(3)
● Liberia	(2)	● APMP	(2)
● Mali	(1)	● UNIDO Asia	(2)



A total of 76 participants attended the 2011 Metrology School, 69 from African countries.

THE PRESENTERS





Experts in metrology from around the world

Distinguished experts from well-known metrology institutes around the world contributed with their unconditional time and support to the success of this event.

THE PRESENTERS



With a career in legal metrology spanning 42 years, Mr Beard's expertise includes the verification of instruments used in trade; assessment of accredited verification laboratories; testing of instruments for type approval; technical training of trade metrologists; and the inspection of instruments and commodities. He has been a key participant in drafting amendments to South Africa's trade metrology legislation, has conducted research on South African specifications for trade metrology technical regulations, and has advised and trained the SADC Legal Metrology Authorities in various aspects of legal metrology.

At present he is employed by the National Regulator for Compulsory Specifications (NRCS), the regulatory body in South Africa responsible for legal metrology, and serves as Technical Specialist for Legal Metrology matters.



Dr Bonnier is currently scientific advisor for several national metrology institutes: INMETRO (Brazil), LNE (France) and UME (Turkey). Within the Consultative Committee of Thermometry he chaired the working group in charge of uncertainties in temperature measurements (WG3). Dr Bonnier was responsible for setting up the national references for thermal metrology in France and is the author of many scientific papers and metrological procedures in thermal metrology.

His present areas of interest include the characterization of thermal-physical properties; thermal metrology; laboratory accreditation; and the evaluation of uncertainty in thermal measurements. He is active in CAFMET, which helps the development of metrology in Africa.



Dr Oswald Chinyamakobvu is a metallurgist, with a PhD in Metallurgical Engineering from Imperial College. In 1998 he joined the Standards Association of Zimbabwe (SAZ) as Operations Director, was closely involved in national standards development, and was his country's representative on the ISO Technical Committees for Medical Devices and Environmental Management, where he became chairperson of some of the working groups.

In June 2006 he joined SADC at their headquarters in Gaborone, Botswana. He has coordinated regional projects related to SQAM/SQMT; was involved in the establishment of a regional accreditation body (SADCAS); took part in negotiations towards the establishment of tripartite cooperation between COMESA, EAC and SADC; and supported SADCA and SADCMEI/SADCMET in their contribution towards the establishment of AFRAC and AFRIMETS respectively.



 Dr Richard Davis,
United States of America

Dr Richard Davis joined the International Bureau of Weights and Measures (BIPM) in Sèvres, France in 1990, and was Director of the Mass Department from 1993 until his retirement in 2010. At the BIPM he was also the Executive Secretary of the Consultative Committee for Mass and Related Quantities (CCM). He developed the “BIPM susceptometer”, a new method of verifying that precision mass standards are sufficiently non-magnetic. His particular interests are mass metrology, precision measurements of fundamental constants, and how fundamental constants can be used to improve the International System of Units (SI); he has been especially involved in a new definition of the kilogram.

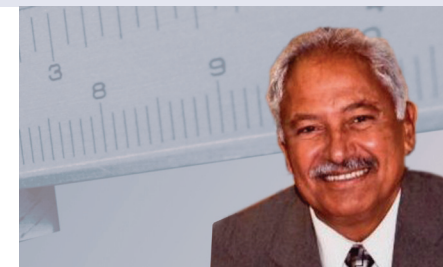
Dr. Davis has been a faculty member of two metrology summer schools held at the BIPM and two “Enrico Fermi” International Schools of Physics, held in Italy.




 Mr Ian Dunmill,
United Kingdom

In 1993, Mr Dunmill became the UK National Weights and Measures Laboratory (NWML)’s OIML manager, responsible for the Secretariat of OIML TC 9/SC 2 automatic weighing instruments, as well as the UK’s point of contact for all OIML matters. In 1999 he became Assistant Director at the BML (the OIML’s administrative arm) in Paris and since then has been responsible for overseeing and following the technical activities and publications of a number of OIML technical committees and subcommittees, as well as having particular responsibility for the OIML’s developing country activities.

He is the OIML’s contact point for liaisons with the WTO, UNIDO and ISO DEVCO, as well as for the regional activities of AFRIMETS and SADC standards, quality, accreditation and metrology structures.



 Prof Dr Ahmed Ali Mohamed
El Sayed, Egypt.

Dr El Sayed is currently Professor Emeritus at the National Institute for Standards (NIS), Egypt. He heads the NIS Office of International Affairs (NIS-OIA) and is also the Assistant Secretary General of the Arab Federation for Metrology (AFM).

He is a chartered engineer, registered by the Council of Engineering Institutions, United Kingdom, and a member of the Institution of Production Engineers, United Kingdom.

He acts as Regional Coordinator of the National Conference of Standards Laboratories International (NCSLI) and is a standing member of the AFRIMETS delegation at the Joint Committee of Regional Bodies of the International Bureau of Weights and Measures (JCRB).

THE PRESENTERS



Dr Erard joined the Laboratoire Central des Industries Electrique (LCIE) in 1970, where he became the head of the RF and Microwave Department, and in 1982 was appointed Director of its Metrology Division. He served as chairperson of the GT-RF (Groupe de Travail sur les Radio-Fréquences) of the CC-EM for 13 years; was rapporteur (now TC-Chair) of the EUROMET Electricity-Magnetism Technical Committee from 1992 to 1995; was designated as French delegate to EUROMET in 1995; and became EUROMET Chairperson in 1998.

In 2006, he took on responsibility for the Technical Committee for Quality (TC-Q), a position he held until 2009. In 2005, he became a member of the CIPM, and in 2007, President of the CC-TF. In 2007, with the creation of EURAMET e.V. as a legal entity, and the formulation of the European Metrology Research Programme (EMRP), he was elected EMRP Chair and oversaw the creation, development and evolution of the Programme.



Dr Lalith Goonatilake is the Director of the Trade Capacity Building (TCB) Branch of the United Nations Industrial Development Organization (UNIDO) in Vienna. Prior to joining UNIDO, he held the position of Professor of Industrial Management at the University of Kelaniya in Sri Lanka. And Director-State Hardware Corporation, Sri Lanka. During his academic career, he also held the position of Sub-Dean, Faculty of Engineering & Technology, and University of Ilorin, Nigeria.

He was instrumental in developing the Trade Capacity Building approach in UNIDO and positioning UNIDO as a major technical assistance provider in the standards, metrology and conformity area. He is a Chartered engineer and holds a PhD in Engineering from the University of Aston, Birmingham, United Kingdom.



Mr Ben Hassine is a Quality Assessor (ISO 17025, ISO 17021 and ISO 17020) and Technical Assessor (Metrology) with the Tunisian Accreditation Council. He has worked as a Senior Expert in Quality Infrastructure with PTB (Germany) and the Islamic Development Bank (BID), and in UNIDO projects. He represents the National Metrology Agency at the International Committee of Legal Metrology (CIML) and is the CGPM Delegate representing Tunisia at the International Bureau of Weights and Measures (BIPM).

He is also the Chairperson of MAGMET (AFRIMETS SRMO) and delegate to the Executive Committee (EXCOM) of AFRIMETS, and is Director of the National Metrology Agency in Tunis. He was elected Chairperson of AFRIMETS in July 2011.

THE PRESENTERS



 Mr Andy Henson,
United Kingdom

In 2000 Mr Henson joined the National Physical Laboratory (NPL) in the UK, setting up and managing the UK's first International Metrology Programme. While Director of International Projects at NPL, he led a number of national and EU funded projects. Later, as EMRP Programme Manager for EURAMET, he proposed and led a suite of European projects aimed at closer collaboration amongst European national metrology institutes.

In early 2010 he joined the International Bureau of Weights and Measures (BIPM) in Paris as the International Liaison Officer. He is a Chartered Engineer and a Fellow of the Institute of Physics. In 2008 Andy was awarded an MBE by Queen Elizabeth II for his services to measurement science.



 Prof Michael Kuehne,
Germany

Prof Michael Kuehne joined PTB, the German National Metrology Institute, in 1977 and was appointed Head of its laboratory for vacuum-ultraviolet radiometry at the Berlin electron storage ring, BESSY, in 1986. In 1991 he became Head of the PTB Department of Temperature and Heat; in 1992 he was appointed lecturer at the Department of Physics of the University of Hanover, and adjunct professor in 1996; in 2001 he became Head of the PTB's Presidential Office and in 2003 he became a member of its Presidential Board as second vice-president. He is also a member of the editorial board of the journal Measurement Science and Technology and a Fellow of the Institute of Physics, United Kingdom. From June 2006 to March 2009, he was Chairperson first of EUROMET and then of EURAMET, the European Association of National Metrology Institutes. In November 2007, he was elected by the CIPM as Director Designate of the BIPM, where he is currently Director.



 Dr Wynand Louw,
South Africa

Dr Louw was appointed to the Council for Scientific and Industrial Research (CSIR), South Africa, in 1986, moving to its National Metrology Laboratory (NML), where, in 1998, he became the Manager of Metrology in Chemistry and General Manager in 2002. From 2005-2007 he assisted the Department of Trade and Industry to write a new South African Act for Metrology. Then, in 2007, he became the Acting CEO of the National Metrology Institute of South Africa (NMISA) and is currently its Director of Metrology.

Over the past 23 years he has built up a wide range of experience in surface analysis, industrial problem solving, national and regional metrology and international metrology. He became the first Chairperson of AFRIMETS and is also the Chairperson of the International Cooperation in Traceability in Analytical Chemistry (CITAC).

THE PRESENTERS



Dr Meintjies is a member of the South African Chemical Institute (SACI), of which she was President in 2003, and a member of the Water Institute of Southern Africa (WISA), where she served as President in 1999. She has extensive experience in standards, quality, accreditation and metrology, including project-managing the process of obtaining accreditation for the chemical, microbiological and hydrobiological laboratories for Rand Water (which supplies potable water to more than 10 million consumers) against ISO Guide 25, and has been involved in a range of accredited commercial conformity assessment services to industry and commerce in South Africa.

She has also been the Managing Director of the Botswana Bureau of Standards, and has published several academic articles in international journals.



Mr Koskei Milgo holds an M.Sc. degree in Food Science and Technology from the State University of Gent, Belgium and an Advanced Certificate in Quality Management from Singapore. He has over eighteen years' experience in standardization and conformity assessment, has worked for the Kenya Bureau of Standards (KEBS) in various functional areas, and was appointed Assistant Quality Assurance Officer in 1985 and Director of the Kenya Accreditation Service (KENAS) in 2008.

He has also made a substantive contribution to the development of the East African Community Standardization, Quality Assurance, Metrology and Testing Act, 2006 (EAC-SQMT Act, 2006), which includes accreditation.



Mr Moturi is Head of the Metrology Department at the Kenya Bureau of Standards (KEBS), where he is responsible for the publication and maintenance of the calibration and measurement capabilities within the framework of the Mutual Recognition Arrangement of the International Committee of Weights and Measures (CIPM-MRA); for ensuring the traceability of the national measurement standards to the International System of Units (SI); and for the implementation and maintenance of the metrology quality management system to underpin and maintain the accreditation status of the laboratories.

He acts as assessor for the audit of laboratories against the ISO/IEC 17025 standard and provides consultancy in metrology.



 Mrs Maureen Mutasa,
Botswana

Mrs Maureen Mutasa has 27 years' diverse experience in the food industry, lecturing and conducting agricultural research, and engaging in standards development and management, and testing and certification.

She joined SADCAS in June 2008 as its first Chief Executive Officer, and has served on various national and international boards: she was Chair of the ISO Policy Committee for developing countries (ISO DEVCO) from 2003 to 2006; Chair of the SADC Cooperation in Accreditation (SADCA); Chair of SADC Cooperation in Standardization (SADCSTAN); and the ISO Regional Liaison Officer for Africa (excluding Arab countries).



 Dr Miguel Viliesid,
Mexico

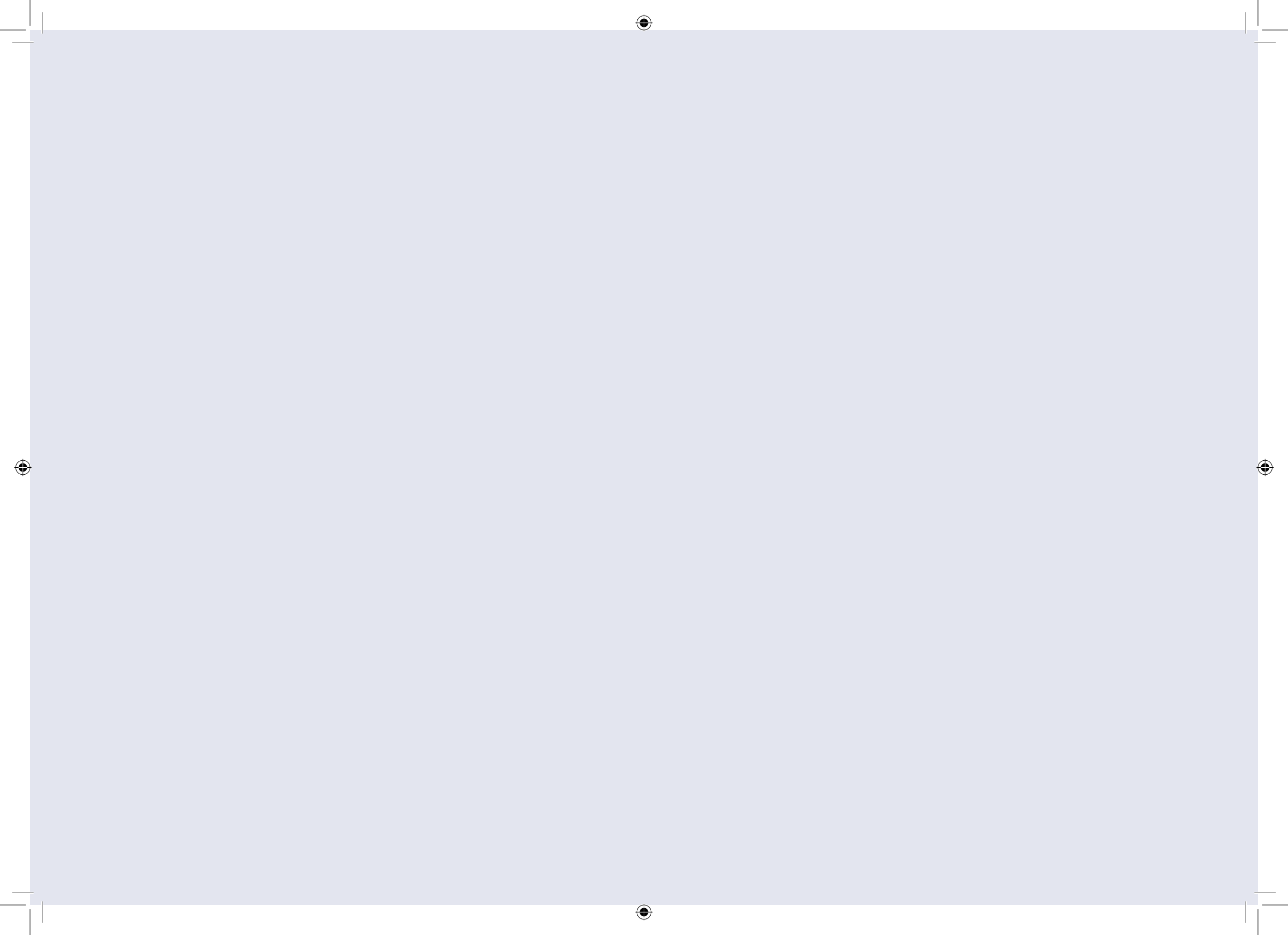
Dr Viliesid has been Head of the Dimensional Metrology Division of the Centro Nacional de Metrología (CENAMI) since its creation in 1993, and has published and presented many papers on metrology and vibrations in technical journals and at international symposia and organized conferences, mainly in coordinate metrology.

He has been the Mexican representative at the Consultative Committee for Length (CCL) of CIPM since 1997, and is president of the Asociación Mexicana de Metrología de Coordinadas (AMMC) and vice-president for the Mexican Section of the North American Coordinate Metrology Association (NACMA). He was Chairman of the Length Working Group of the Sistema Interamericano de Metrología (SIM) and, for the last 15 years, has been president of the Sub-comité de Metrología Dimensional del Sistema Nacional de Calibración (SNC).



 Ms Kathrin Wunderlich,
Germany

Since 2009, Ms Wunderlich has been working as project coordinator at PTB Germany, where she is responsible for the Pan-African and SADC region projects. Prior to joining PTB, she worked for the International Expo 2008 in Saragossa, Spain, on "Water and sustainable development", and at the Institute for Energy and Environmental Research in Heidelberg, Germany. She was also a project assistant at the Global Nature Fund in Radolfzell, Germany and ProgTrans AG in Basle, Switzerland. She has published on several topics, including the development of sustainable tourism, the environmental aspects of air traffic management, and eco-balance in the field of traffic and environmental education. Ms. Wunderlich is a member of the Heidelberg Geography Association.





“...Norway’s experience of cooperation with UNIDO in other regions has been very positive indeed...”

... (the Metrology School) is, in fact, a unique opportunity to share and receive knowledge specially designed for the needs of Africa and which, needless to say, is of invaluable importance to the economic development of this continent.”

Mr. Per Ludvig Magnus
Ambassador of Norway to Kenya.



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Trade Capacity-Building Branch
tcb@unido.org